for which it was clearly not intended: to impose or force inappropriate solutions on wildlife conservation problems, especially in developing countries. This ignores the fact that if the protection and management efforts in the field are ineffective, CITES can do little more than monitor the demise of wildlife populations. It is necessary for CITES to facilitate positive action to improve the real protection and management of wildlife.

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Chapter 2

CITES and the Causes of Extinction

Morné A du Plessis

Introduction

As concerned citizens and biologists we are anxious to understand how natural diversity can be maintained in a world of rapidly diminishing resources – resources that are important to the livelihood of human beings as well as to the millions of other organisms that share this planet. Human activities are causing major changes to the Earth's biota. Extinction, the ultimate change, is occurring today across a broad range of terrestrial and aquatic habitats. Although much of this biodiversity crisis is almost certainly due to human impact during recent centuries, we still do not effectively prioritize conservation action on the basis of what we know about the causes of extinction. In this chapter I shall attempt to show, in particular, that CITES does not focus on the most important threats to wildlife.

Extinction and Phylogeny

Life on this planet has existed for at least 3.5 billion years, a history marked by a series of diversification events. Global biological diversity is probably now at an all-time high. Plant diversity, for example, has been increasing appreciably since about 700 million years ago and increasing rapidly since about 100 million years ago. Such proliferation is evident despite a series of mass extinction events. A comparison of these trends against estimates for the longevity of species is illuminating. Although such estimates are highly tentative, particularly for terrestrial organisms, a range of longevity between 1 and 10 million years for most species seems broadly acceptable. This marked turnover in species signifies that an enormous amount of taxa has

become extinct. Indeed, there is general agreement that more than 99 per cent of all the species that ever existed have become extinct. Species extinction is therefore a natural process that occurs without the intervention of man. However, there is little doubt that man has been the cause, either directly or indirectly, of a large number of extinctions. This elevated, man-induced extinction rate far exceeds the background extinction rate and, at present, it appears to be increasing still further.

Rarity and Extinction

The role of rarity in the recognition and classification of threatened and endangered species is unclear. To some, rarity and the threat of extinction are almost synonymous and it is widely assumed that rarity is associated with increased extinction risk, while others recognize that rarity per se is insufficient to classify a species as being at high risk of extinction. Some rare species persist and they do so because they have biological characteristics that allow them to become rare and yet then enable them to endure in such a state. But where there are processes causing a continual decline in numbers, a species may well be at risk. A better understanding of the causes and consequences of rarity would assist greatly in the setting of conservation priorities.

Variations on the Extinction Theme

Although extinction is usually defined as the total disappearance of a species from the face of the earth and an absence of sightings for a period of at least five decades, it is important to recognize that there are variations on this somewhat strict definition.

Commercial extinction

Commercially important species of mammals, in particular, are susceptible to over-harvesting, sometimes to the point of near extinction. Examples include the blue whale, the right whale, the northern elephant seal, the American bison and the black and white rhinoceros. However, the commercial exploitation of wildlife can lead to two very different end results. For resources that are harvested in large quantities, a point can be reached at which it becomes economically unviable to continue harvesting; this happens with numerous fish stocks. In these instances, commercial unviability can result in a positive feedback loop leading to persistence and sometimes recovery. In other cases, the increasing rarity of an organism may add the prized element of exclusivity to the value of the commodity and this can drive the price even higher, justifying more expenditure on harvesting. This has been the case with rhino horn.

Population extinction

Population extinctions can have important consequences for the species as a whole, especially where marked genetic variation exists between populations or where populations form part of a larger metapopulation. Moreover, species extinction is simply the endpoint of a process of population extinctions. So, if we want to expand our focus from the preservation of endangered species to include the prevention of endangerment in the first place, we should study population extinctions as well. In addition to being an important step on the path to species extinction, population extinctions can have important consequences of their own. The loss of local populations means the loss of the functional role of these species. This may be particularly important where the species are keystones or 'ecosystem engineers'. These are the species that play an especially important role in shaping and maintaining an ecosystem. Extinctions of populations of economically important species can also have direct economic and social effects.

Regional extinction

Species conservation activities are usually effected and coordinated at the level of individual states. So, extinction from these politically defined regions may attract particular attention from conservation agencies within those boundaries. But it is also the case that the response by nation-states may not reflect the seriousness of the threat to the species as a whole. For example, even though less than 10 per cent of the Blue Swallow's (*Hirundo atrocaerulea)* distribution range (and total population) formerly fell within South African borders, its decline has attracted disproportionately large conservation resources relative to other declining species in that country.

Threats

Instead of concentrating on global extinctions (which are often difficult to establish unequivocally) it is vital to assess and monitor the status of, and threats to, both species and their habitats if global trends of species diversity are to be established. To this end, IUCN has developed a quantifiable set of criteria to assist with the task of assigning an objective threat status to species of concern (Mace and Collar, 1994). Thinking in terms of the threats organisms face equips one to develop a strategy for minimizing the future impacts on the species and populations of concern. The first step towards the prevention of global extinction is the identification and documentation of species, ecosystems and landscapes, and the threats that face them.

Habitat loss

There is agreement that the greatest threat to both animal and plant species lies in the loss of habitat. In many instances organisms disappear from a system even before it has been totally transformed; this is usually the result of the disruption of the functional processes necessary to sustain, intact, the species complement. Although outright habitat destruction clearly has most impact, habitat degradation, as a result of selective harvesting (including logging), heavy grazing or seasonal burning, certainly has an effect by causing such things as loss of nest-sites, direct disturbance and alterations to the mix of plants species, including food plants. Additionally, there are many subtle pressures linked to habitat degradation that are poorly understood, as the effects may vary from species to species and even seasonally within species.

The factors causing habitat loss may vary within and between habitats. For example, in mesic areas, conversion to large-scale agriculture (eg, by fire, stocking rate, chainsaw, plough or bulldozer), clearance by small-scale farmers, large-scale planting or logging, infrastructural development (eg, buildings, dams, power lines and roads) and mining are the main agents of habitat transformation. In drier habitats, conversion to rangeland, exotic plantation, agriculture, overgrazing and excessive fuelwood collection are the principal direct causes of habitat loss and degradation.

However, the above mentioned agents are not in reality the underlying causes of habitat loss. Macro-economic problems faced by many developing countries are the driving force behind the conversion

of habitats into apparently economically attractive land-use options as nations struggle to meet repayments on international debts. Many countries have been, and are, plundering their habitats or clearing them to reach mineral deposits in order to satisfy the insatiable economies of the developed consumer countries. In many cases, rural people have been displaced by dollar-earning commodity crops and are forced to wreak their own slash-and-burn devastation in marginal areas, thus exacerbating the over-arching problem of habitat loss. In addition to the dire economic circumstances faced by many developing countries, action to counter habitat loss is hindered by:

- domestic legislation (in particular with respect to land tenure);
- the absence of incentives for 'good practice';
- corruption among officials;
- a lack of political interest in conservation; and
- inadequate human and financial resources.

The consequence of such extensive processes of habitat loss is that the geographical distribution of many threatened species has shrunk so drastically that they survive in only a few fragments of their former ranges.

Over-exploitation

Populations of commercially viable species may decline rapidly if exploitation occurs at levels that exceed their reproductive potential. Even superabundant species can become extinct in a few years if exploitation is excessive. However, commercial exploitation is seldom, if ever, the sole cause of extinction.

The passenger pigeon (*Ectopistes migratorius*) showed a spectacular decline in numbers from billions in 1810, to around 200 million in 1870, to one captive female only 40 years later, and finally, extinction in 1919. This is frequently used as a classic example of overkill leading to extinction (King, 1987, and references therein). However, Bucher (1992) has recently presented a convincing counter-argument. He contends that the passenger pigeon became extinct primarily as a result of forest destruction and fragmentation, particularly in its northern breeding grounds. The combination of the loss of critical breeding habitat and the absence of social cooperation among the birds in food finding at low densities would have been enough to lead to the extinction of this species even without

the killing of a single bird and despite the existence of considerable remaining forest.

Large harvests are not necessarily a sign of over-exploitation. More than 10 million waterfowl are killed by North American hunters in a regulated annual harvest, but, barring a few exceptions, this does not exceed the reproductive success of the species. Commercial exploitation features in neither academic nor textbook treatments of extinction (Hobbs and Mooney, 1998; Lawton and May, 1995; Novacek and Wheeler, 1992).

Introduced species

Biotic invasions are ongoing worldwide, the full extent of which has yet to be fully documented. Nevertheless, invasions have become recognized as a major factor forcing global environmental change (Vitousek *et al*, 1996). Perhaps one of the best examples of multiple threats to a single species posed by a variety of introduced organisms is the case of the Mauritius parakeet (*Psittacula echo*). This species suffers nest predation from crab-eating macaques (*Macaca fascicularis*) and rats, and competes for food and nest-sites with the introduced ring-necked parakeets (*P krameri*). Moreover, the last fragments of its native forest habitat are at risk from encroachment by introduced plants.

Pollution and pesticides

Pesticides are often cited as a major cause of the decline of natural insect populations and their use in restricted natural habitats must be viewed with concern. However, the effects of pesticide use, in particular the side-effects of widespread agricultural and forestry pesticides (which have sometimes been applied without concern for problems of drift and contamination of nearby non-target habitats), have been difficult to document.

Decreasing range size

Much of the current scientific and public concern over the extinction crisis revolves around the loss of species globally. Most of the benefits which biodiversity confers on humanity, however, are dependent on

large numbers of populations of species, because each population ordinarily provides an incremental amount of an ecosystem's value or service (Hughes *et al*, 1997). Hughes *et al* presented a case in which population diversity and area correspond roughly in a one-to-one fashion over ecological time. Thus, when 90 per cent of an area is destroyed, about 90 per cent of the populations inhabiting the original area are exterminated (as opposed to roughly 50 per cent of the species as predicted by the species-area relationship).

A Bird's View of Threat

Birds are the best known taxon. Collar *et al* (1994) produced the first comprehensive analysis of the threats facing them, using the revised IUCN criteria. It is thus useful, when making a quantitative estimation of the various threats that may erode global species diversity, to consider both birds in general and a selection of sub-divisions within the group.

A total of 1,111 bird species, 11 per cent of the world's avifauna, are threatened in one way or another (Collar *et al*, 1994). Additionally, a further 10 per cent of species are considered as potentially at risk. Overall, more than one-fifth of all bird species give some cause for concern in terms of the likelihood that they could be at risk of extinction. Of the 1,111 species considered to be threatened, 52 per cent

Table 2.1 *Breakdown of the relative importance of threats to various subsets of birds*

	Number of species	*Threat (%)*							
		Habitat loss	*Small range*	*Subsistence hunting*	*Introduced species*	*Trade*	*Natural causes*	*Unknown*	*Other*
Restricted-range species (Bibby *et al*, 1992)*	2,609	63.0	–	6.0	8.0	–	–	17.0	6.0
Threatened birds (Collar *et al*, 1994)*	1,111	51.9	23.2	7.6	5.8	2.6	3.3	2.5	3.1
Threatened African birds (this study)**	151	85.4	37.7	17.2	1.3	1.3	4.6	3.9	–
Threatened parrots (Juniper and Parr 1998)**	90	81.1	–	–	–	43.3	–	–	–

* giving equal weight where multiple threats are operating (ie total = 100%)
** giving overall contribution of each threat type (ie total = >100%

are considered to be threatened chiefly by habitat loss and alteration, 23 per cent by small range or population, almost 8 per cent by subsistence hunting, 6 per cent by introduced species, while commercial trade threatens less than 3 per cent of such species (see Table 2.1). A similar picture emerges from a brief survey of some particular categories of birds.

Restricted-range species

Some 20 per cent of all birds are confined to just 2 per cent of the earth's land surface. Bibby *et al* (1992) collected distribution records of all bird species with breeding ranges below 50,000 sq km (ie, the size of Denmark or Costa Rica). They found that of 2,609 restricted-range species, 63 per cent are threatened by habitat destruction, 8 per cent by introduced species, 6 per cent by hunting (mainly for subsistence or because they are pests), 17 per cent by unknown factors and 6 per cent by other factors (including trade, disturbance, pesticides, poisons, fisheries and natural causes, etc) (see Table 2.1).

Threatened African species

Africa provides a suitable example for a continental perspective of the threats facing birds as it not only holds a significant proportion of the total number of species, but its biota are also subjected to every conceivable form of threat. Furthermore, the use of wildlife features strongly in the cultures of most African nations and in many cases the use of wildlife presents one of the few practical means of earning a livelihood. Thus, while the commercial use of wildlife may be viewed with circumspection in the developed world, it is a rare novelty to be able to take this position in Africa.

Of 1,700 bird species occurring in Africa, 151 species (or almost 9 per cent) are considered to be threatened (ie, excluding those species considered near-threatened) (Collar *et al*, 1994). Of these, 85 per cent of species are threatened by habitat loss or degradation, 18 per cent by subsistence hunting, and 11 per cent by pollution and pesticides. Commercial trade threatens only 2 species (ie, less than 2 per cent), only one of which is restricted to the continent (see Table 2.1). So, while a higher proportion of African species are threatened by subsistence hunting, habitat loss is again the most important threat, with commercial trade being much less significant.

Parrots

Among birds, parrots are the group most subject to commercial trade. A wide range of human societies, from the indigenous people of the rainforests to the technologically advanced societies of North America and Europe, place a particular value on parrots as pets. This is, indeed, not a recent occurrence as parrots have featured as companions to humans almost as long as recorded history itself. Data collected under the obligations of signatories to CITES, and analysed by the IUCN's Wildlife Trade Monitoring Unit, reveal the scale and breadth of trade in parrots (see Mulliken, 1995). Between 1980 and 1992, 247 species of parrot were reported in international trade, with 156 of them traded over that period in volumes exceeding 1,000 birds annually. If one were to add to this the illegal trade and the trade within national boundaries, these figures would be likely to increase substantially. In the light of this one might expect parrots to be threatened by commercial trade and, indeed, this is the case.

The parrots at risk of extinction and those deemed near-threatened face a wide range of pressures. In general, however, the principal sources of threat arise from habitat loss and the collection of birds for live trade (Juniper and Parr, 1998). Of 90 species at risk of global extinction, 81 per cent are threatened by habitat loss or degradation, 43 per cent by trade in live birds, with at least 31 per cent threatened by both pressures. Less than 7 per cent are considered to be threatened by factors other than these two (see Table 2.1). It is useful to compare the threats to parrots in Australia and South America. Between them, they provide the home to almost two-thirds of all parrot species. Unlike South America, however, Australia has implemented a total ban on trade in parrots for almost forty years.

The New World harbours around 140 parrot species, of which no fewer than 41 species (29 per cent) may be considered at some risk of extinction (Collar *et al*, 1994). Of these, almost 90 per cent are threatened by loss of habitat and 41 per cent by commercial trade. Habitat loss is the sole threat to the persistence of 14 species (34 per cent); only one species (2 per cent) is considered threatened by trade alone and 16 species (39 per cent) from a combination of habitat loss and trade. Of the 55 parrot species that occur in Australia, ten species (18 per cent) are at some risk of extinction (Collar *et al*, 1994). Of these, all are at risk from habitat loss and 40 per cent from a combination of this and trade. Although a smaller proportion of the Australian parrot fauna is considered threatened when compared to that of the New World, the threat profiles of the parrots inhabiting these

Table 2.2 *Breakdown of threats facing parrot species of the New World (equivalent to the Neotropics) and Australia*

Threat	Equal weighting (%)		Absolute frequency (%)	
	New World 41 species	Australia 10 species	New World 41 species	Australia 10 species
Habitat loss and alteration	57.5	43.4	87.5	100
Trade (of live birds and egg collection)	16.6	17.5	41.5	40
Hunting (subsistence and persecution)	4.5	5.0	14.6	10
Introduced species	0.6	13.3	2.4	10
Other factors (disturbance, small range, natural causes)	20.8	20.8	48.8	60

Note: The species are classified as 'critical', 'endangered' or 'vulnerable' by Collar *et al* (1994). In this table threats have been given equal weight where multiple types have been identified, and absolute weighting according to the proportion of species affected by each threat.

regions are virtually identical (see Table 2.2). The higher percentage of threatened New World parrots can be ascribed largely to severe pressures on their habitat.

This survey of the threats both to birds in general and to particular categories of birds confirms the general picture of the threats to wild species that was outlined in the previous section. Habitat loss is by far the most important threat to birds and commercial trade is typically a serious threat to a much smaller number of species. A partial exception to this is provided by parrots. But even for parrots, where commercial trade is a significant threat, habitat loss is more important.

The Response of CITES

In view of the above analysis of the nature of the threats to species, CITES appears to be concentrated on just a small part of the problem. For CITES, as the name suggests, focuses on just one threat to species, that posed by international trade. It responds to the threat by attempting to halt or restrict that trade. Species can be placed on either Appendix I or Appendix II of the convention. International commercial trade in Appendix I species is almost completely banned and trade in Appendix II species is subject to regulation. However, as we have seen, for most threatened species commercial trade is not a significant threat. Habitat loss is far more important and CITES has no remedy for this problem. Even for the relatively small number of

species for which commercial trade is a threat, habitat loss would often appear to be a greater threat. The fact that CITES is only addressing a small fraction of the threats to species might not matter so much were it not the case that CITES is perhaps the most important and well-known conservation convention. It helps to determine where conservation efforts are directed and if this convention does not address the most important threats, then something is awry.

There are other weaknesses within CITES. Even for those species where trade may be a threat, it is not clear that the convention always deals effectively with it. This is partly because imposing restrictions on international trade in wild species sometimes just has the effect of driving the trade underground. For example, substantial numbers of parrots change hands across international boundaries despite the existence of CITES. Some workers estimate this type of activity to be at least equal in magnitude to the legal trade. The comparison between Australia and the New World is instructive here. Even though Australia has implemented a total ban on the export of its parrots for almost 40 years, trade in live birds apparently poses as much of a threat to Australian parrots as it does in the New World. Additionally, species listed on Appendix II are sometimes captured in a country where a wildlife export ban exists and then moved to a country where documentation of local origin can be obtained, permitting 'legal' exportation. Furthermore, even when CITES is able to control international trade, domestic trade is left untouched. Harvests for international trade represent only a part of the actual offtake of wild species. In the case of birds, many are trapped and traded at the national level. These numbers will in some cases be higher than the numbers exported.

There is also some evidence that where species are traded internationally, the convention appears to be responding to something other than the degree of threat alone. Of 90 parrot species that are listed by Collar *et al* (1994) as being under global threat, 33 of these species appear in Appendix I of CITES. A further nine non-threatened parrot species are listed in Appendix I. All other parrot species, with the exceptions of the ring-necked parakeet, budgerigar (*Melopsittacus undulatus*) and cockatiel (*Nymphicus hollandicus*), are included in Appendix II. It thus appears that the listing of parrots on Appendices I and II respectively, might relate largely to the level of commercial trade and not to the degree of threat to the species.

Because of the power and significance of CITES, it has the effect of encouraging research and funding into the management of species that are of most commercial interest instead of species that are most en-

dangered. It is a perpetual problem to find funding for species on Appendix I. But species on Appendix II, especially those threatened by a trade ban, absorb huge resources, as commercial interests and nation states endeavour to prove that the species can withstand trade and should not be moved to Appendix I. A case in point is that relatively large sums of money have been spent on the orange-winged Amazon (*Amazona amozonica*), which is a common parrot with a wide distribution, while almost no attention has been paid to the vinaceous Amazon (*A vinacea*), which is under extreme threat. Closer links between CITES and the CBD, which could source funds for critically endangered species on Appendix I, may be one way of tackling this problem.

Links with the CBD would also provide a way of placing CITES in a wider context where all the threats to species are dealt with, for the CBD explicitly recognizes that there are a wide range of threats to species, including habitat loss. At the moment CITES appears to be regulating the international trade in species with little attention being paid to how these activities relate to the conservation of biological diversity in general and species in particular. The activities and objectives of CITES need to be reassessed so that they correspond more closely to the actual threats faced by species.

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THREATENED CONVENTION

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in Endangered Species of Wild Fauna and Flora

Edited by JON **HUTTON** and BARNABAS **DICKSON**

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